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RT-11 Priorities for 2027

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Introduction

- RT-11 was established to accommodate DTE2 analyses outside the remit of RT-01 to RT-09
- Its scope subsequently expanded to include broader JET analyses supporting ITER, notably through the ITB and separatrix working groups.
- Generally one of the largest single RTs by resource in 2022-25
  - 10.5% of total participation budget in 2025 out of 18 RTs

Scientific objectives

→ RT-11 now focuses on the highest-priority topics for ITER and on completing ongoing analyses by the end of 2027.

- Other work that does not align directly with these aims *may* still be considered but not necessarily where we can direct participation funding – need to focus limited budget on specific high-priority topics

- **D1: Complete analysis of parameter dependence of separatrix properties to support extrapolation to ITER operational scenarios**
- **D2: Complete analysis of experiments utilising novel ICRH schemes relevant to ITER to support extrapolations of ITER operational scenarios**
- **D3: Complete analysis of experiments that provide specific information on isotopic effects, high-current operations and competition between gas and pellet fuelling relevant to ITER**
- **D4: Complete analysis of L-H transition studies and databases including divertor configurations, to support extrapolation to ITER operational scenarios.**

Research areas reviewed in September

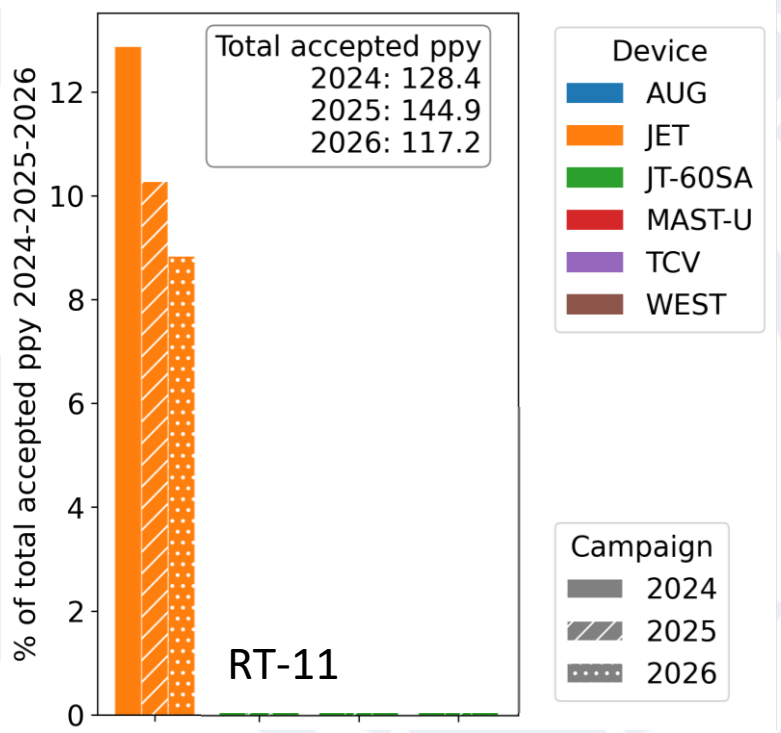
- Six main areas reported progress and future plans at the Review meeting:
  - Separatrix working group
  - ITB working group
  - LH working group (M18-14/M21-14)
  - JET baseline (M21-03)
  - ICRH studies (M18-05/11)
  - Isotopic effects on transport (M18-24)

- Results and future plans of these topics presented at September review meeting

- These plans provide the basis for defining RT-11 priorities for 2027
  - Many thanks to SC/Topic leads for their work and input.

Progress towards completion

- Review meetings over recent years have shown clear scientific progress across RT-11, with ongoing studies progressively reaching completion
- As studies reach completion, overall effort and resource requests are gradually decreasing
- In 2027, the programme will focus on five research areas, with continued support for the ITB group to finalise outstanding work for journal submission
- Deliverables have been revised to emphasise completion of ongoing analyses



A further aim for 2027 is to transfer expertise developed on JET to JT-60SA

Separatrix working group

- Investigate **separatrix** values and gradients around **L-H transition**
  - assess divertor configuration impact on the L-H transition in the SepOS framework
  - extend to different Ip, Bt, isotopes

- Wrap-up analysis of H-mode nsep in **different divertor configurations** at JET
- impact of isotope mass on nsep and neutral pressure → in collaboration with M21-12

High Priority

→ SOLPS or EDGE2D-EIRENE simulations with extended grid could be useful to learn more about them but staff missing → *could be performed revisiting previous analysis*

- Study **near-and far-SOL decay lengths** in JET **XPR** discharges and possibly assess **edge Zeff** to include impurities in recently developed turbulence models → *to be pursued within* **[RT-05]**

- Study the impact of separatrix quantities on the **QCE access** → *to be pursued within* **[RT-02]**

L-H working group (M18-14/M21-14) (1)

M18-14/M21-14 objectives:

- **L-H/H-L transition physics**: understand power thresholds, critical profiles, and edge conditions governing transitions
- **Isotope and main effects**: quantify the impact of isotopic mix, impurities, plasma configuration, and transition dynamics
- **Transport and edge physics**: investigate turbulence, heat transport, electric fields, SOL/divertor behaviour, and dithering phenomena across transitions
- **Predictive tools for ITER/DEMO**: develop databases, scaling laws, and simulations to improve predictive capability and support future reactor operation

Priority for 2027: complete ongoing analyses addressing these objectives

LH working group (M18-14/M21-14) (2)

(Non-exhaustive) plans for 2027 regarding JET L-H transition studies

- L-H transition interpretation — High Priority
  - Comparison of JET P_{LH} metallic scaling to other devices
  - Analysis of critical profiles at the L-H transition: investigation with Doppler reflectometry for $v_{\perp}$
  - Analysis of P_{LH} dependencies in B_t scan at fixed I_p, n_e → *to be compared within RT-01*
  - Explore impact of L vs H mode background equilibrium on plasma
  - Comparison of H-L JET data with other devices [E. de la Luna]
- Predictive and GK simulations: — High Priority
  - GENE/TGLF understanding of the A_{eff} effect on P_{LH} with asymmetric $\gamma_{E\times B}$ effect
  - Isotope effect, role of global effects (e.g. E×B shear), other dependencies with GENE-X
  - Particle transport modelling in SOL including fuelling and pumping to help understanding JET PLH configuration effect
  - Effect of impurities on plasma turbulence across L-H
  - GENE modelling to understand transport in the L-H density branches of JET D-T plasmas
  - JETTO/TGLF modelling of JET LH transition
- MHD theory:
  - Check the analytical frequency scaling for M-mode towards JET data and other devices
  - Explore the use of high-frequency oscillations as MHD markers, improve frequency formula, effect of energetic particles– *in synergy with RT-09*
- Data analysis: — High Priority
  - Edge HRTS measurements at low density, analysis of different Ip, Bt, and isotope (H)
  - Model improvement/validation of automated JET confinement/transitions, writing ppf from the tool
  - Interact with L-mode [A. Kirjasuo, T. Tala] and H-mode [G. Verdoolaege, M. Maslov, L. Frassinetti]
  - Isotope impact on dithering frequencies and bolometry reconstructions across dithers
  - Reflectometry, interferometry and HRTS analysis of edge profiles at L-H transition
  - Turbulence characterization with KG8c diagnostic. Evolution of the turbulence along the heating ramp: density fluctuation level, auto-correlation time, radial correlation length

JET baseline scenario (M21-03)

97927	**on the path towards 4.0 MA, low q95, Priority** • good pulse at 3.8 MA • ELM activity sustained • nominal gas 3E22 s^{-1}	**3.8 MA / 3.3 T**
98004	**on the path towards 4.0 MA, low q95, Priority** • good pulse at 3.8 MA, • ELM activity sustained, • lower gas (2.5E22 s^{-1}) and higher toroidal field with respect to JPN 97927	**3.8 MA / 3.6 T**
96885	**on the path towards 4.0 MA, low q95** • lower priority • Ip ramp is slower • IRE changes density • ELM activity sustained • nominal gas 2.6E22 s^{-1}	**3.8 MA / 3.3 T**
96888	**on the path towards 4.0 MA, low q95** • lower priority • Ip ramp is slower • IRE changes density • ELM activity sustained • nominal gas 2.3E22 s^{-1}	**3.8 MA / 3.3 T**
97943	**on the path towards 4.0 MA, low q95, Priority** • ELMs are disappearing after 52 s • nominal gas 2.2E22 s^{-1}	**3.8 MA / 3.3 T**
97981	**on the path towards 4.0 MA, low q95, Priority** • ELMs are disappearing after 50 s • nominal gas 1.6E22 s^{-1}	**3.8 MA / 3.3 T**
97985	**on the path towards 4.0 MA, low q95** • ELMs are disappearing after 50 s • nominal gas 1.2E22 s^{-1}	**3.8 MA / 3.3 T**
98005	**Priority**: best 4 MA pulse with the ITER-like wall	**4.0 MA / 3.6 T**

Plans for 2027:

- Continuation of GK analysis of baseline plasmas (core and pedestal)
- Resistive stability pedestal analysis
- Neutronic analysis

High Priority

- Analysis of high current pulses and ELM behaviour
- Core-edge modelling of DTE3 pulses

Potential impact on ITER MoU

- *Comparative analysis with other scenarios*.

High-current discharges are ready for analysis, with equilibrium reconstructions, TRANSP analyses, impurity characterisation and bolometric reconstructions available.

ICRH studies (M18-11/12, M21-05)

Summary of main results in 2026 and plans for 2027

High Priority

Alpha-particle studies in D-^{3}He plasmas in support of JT-60SA, D-(D$_{NBI}$)-^{3}He scheme: synergy between the analysis of past JET experiments and JT-60SA scenario development

- [JET] S.L. Fugazza et al., *Plasma Phys. Control. Fusion* **68**, 035009 (2026)
- [JT-60SA] R. Coelho et al., *Nucl. Fusion* **66**, 086029 (2026)
- [JET/2027] Modelling and analysis of the JET pulse with off-axis D-(D$_{NBI}$)-^{3}He scheme
- [JET/2027] Comparison between the D-(D$_{NBI}$)-$_3$He and $\omega = 3\omega_{ci}$(D) ICRF scenarios for neutron enhancement and alpha-particle generation [M. Nocente et al.]

Should be included in JT-60SA

- **Optimized scenario for MeV-range fast-ion generation for early tests of EP modelling and diagnostics in ITER SRO,** D-(^{3}He)-H scheme
  - Impurity analysis completed: A. Chomiczewska et al., *Nucl. Fusion* **66**, 106053 (2026)
  - [2027] Document the impact of ICRF antenna phasing on fast-ion generation and AEs [Y. Kazakov et al., in preparation]
  - [2027] Power deposition analysis to reveal the impact of AEs (e.g. PION / JINTRAC modelling)

- **Optimized scenario for increasing bulk ion heating,** T-(^{9}Be)-D scheme
  - Impurity analysis completed: A. Chomiczewska et al., *Nucl. Fusion* **66**, 106053 (2026)
  - [2027] Document the comparison between the 3-ion and H minority schemes for bulk ion / electron heating in D-T ~ 50%-50% plasmas [Y. Kazakov et al., in preparation]

Isotopic effects on transport (M18-24)

Plan for 2027

High Priority

- Species scaling between the Deuterium and Helium discharges (on-going)
  - Confinement found to be better in He than D
  - GK simulations of D versus he have been initiated
  - High prio for completion

- Isotope scaling in mixed H-D-T plasmas (to be started in autumn 2026)
  - Comparisons between pure H, D and T plasmas done
  - Including data from M18-21 on mixed H/D/T plasmas will extend dataset
  - Started in late 2026, High prio for completion in 2027

- Isotope scaling in Ohmic discharges +momentum transport and intrinsic torque (started)
  - Comparisons started in 2026, aiming for completion in 2027, High prio for completion 2027

- Possibly a comparison with future JT-60SA isotope scaling data (to be seen)
  - A possible extension of the above work supporting scenario design work on JT-60SA
  - Could be carried out in 2027
  - Medium prio

Should be included in JT-60SA

2027 expected publications:

- L. Chone & T. Tala, “Comparison of dimensional Helium and Deuterium plasmas”, in preparation
- A. Kirjasuo et al., “Isotope dependence in intrinsic torque in JET ohmic pulses”, in preparation
- K. Tanaka et al., “Isotope scaling in ohmic plasmas”, in preparation

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Additional proposals and funding priorities

- Additional proposals for JET analyses outside RT-01 to RT-09 and the established RT-11 research areas are welcome
- Priority in allocating resources will be given to completing work already underway within RT-11
- New proposals must demonstrate a clear contribution to closing physics gaps for ITER and alignment with the RT-11 scientific objectives

Summary

- RT-11 has made clear scientific progress, with studies reaching completion and overall effort and resource requests gradually decreasing.
- Funding priority will be given to completing ongoing activities by the end of 2027, with a focus on the remaining physics gaps most relevant to ITER.
- Activities that fit the remit of other RTs should be pursued within those RTs, in coordination with the relevant teams.
- Transferring expertise developed on JET to JT-60SA is a priority for 2027.